

**Amendments to the Specification:**

Please replace Paragraph [0004] with the following amended paragraph:

[0004] Historically, there has been considerable commercial interest in the optical properties of rare earth activated alkaline earth (AE) aluminates due to their suitability in a variety of applications. Significant growth has taken place in markets such as opto-electronics, telecommunications and optically active commercial products including architectural lighting, building products and way-finding systems. With respect to the applications in the artificial lighting and illuminated display technology areas, AE aluminate materials have recently become important due to their greatly improved persistent photoluminescence properties relative to existing phosphors based on zinc sulfide (ZnS) and related phosphors. Among the most actively studied and commercially useful aluminates are those based on the system SrO-Al<sub>2</sub>O<sub>3</sub>, in which a number of stoichiometric oxide compounds are formed and remain stable at room temperature. Several of these oxide phases become optically active when ~~alloyed or~~ doped with certain rare earth metals (REM's). The optical emission is attributable to the modifications of the electronic structure that arise relative to the ~~unalloyed or~~ non-doped host aluminate crystal.

Please replace Paragraph [0016] with the following amended paragraph:

[0016] The present invention provides an improved photoluminescent phosphor based on the alkaline earth aluminates. Examples of the new phosphor include SrAl<sub>2</sub>O<sub>4</sub>:Eu,Dy doped with Sc (via incorporation of Sc<sub>2</sub>O<sub>3</sub>), SrAl<sub>2</sub>O<sub>4</sub>:Eu,Dy,Gd doped with Sc, SrAl<sub>4</sub>O<sub>7</sub>:Eu,Dy doped with Sc and Sr<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>:Eu doped with Sc. Improvements in the long time persistent afterglow characteristics of the photoluminescent material are achieved by undertaking various doping or

co-doping procedures that involve the use of scandium oxide or other scandium containing feedstocks (such as chlorides or fluorides of Sc) in combination with rare earth containing oxides or feedstocks. Examples based on Eu, Dy, and Gd are provided, but the invention is applicable to all rare earth additions mentioned above. In practice, acceptable performance improvements are obtained by adding Sc in the form of  $Sc_2O_3$  to the above mentioned strontium aluminates in the range of 0.01 to about 3.0 mole percent. Although the present invention is discussed as having a base alloy material comprising strontium (Sr), it will be understood by those skilled in the art that similar base elements may be utilized, such as barium, magnesium, calcium or any combinations thereof.

Please replace Paragraph [0021] with the following amended paragraph:

[0021] In one application of the present invention to produce  $SrAl_2O_4:Eu,Dy,Gd,Sc$  the following materials and quantities were combined in a powder mixer:

$SrCO_3$  (1.0 mole)

$Al_2O_3$  (1.0 mole)

$Eu_2O_3$  (0.005 mole)

$Dy_2O_3$  (0.01 mole)

$Gd_2O_3$  (0.005 mole)

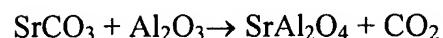
$Sc_2O_3$  (0.005 mole)

$B_2O_3$  (0.2 mole),

Please replace Paragraph [0022] with the following amended paragraph:

[0022] The powdered materials are then agitated for several minutes in a blending vessel in order to achieve a uniform powder mixture. Subsequent to mixing the powder is loaded into a

pelletizing press and isostatically compacted under a pressure of 25,000 psi. The powder pellets are then loaded into a circulating air furnace at a temperature below about ~~250°C~~ 250°C until a uniform temperature is achieved. The pellets are then heated to a temperature above ~~800°C~~ 800°C in a circulating air furnace for a period of 4 to 8 hours in order to permit calcination of the strontium carbonate followed by formation of the strontium aluminate according to the intended stoichiometric reaction. An example reaction is:



Please replace Paragraph [0023] with the following amended paragraph:

[0023] Subsequent to this reaction sintering step, the sintered material is optionally crushed or milled to an intermediate powder form of 120 mesh and then re-pelletized according to the procedure described above. However, in cases where the initial pellets possess a high surface to volume ratio the re-crushing step may not be necessary. The powder or pellets are then heated to a temperature between ~~1100~~ 1100°C and ~~1350°C~~ 1350°C for a period of 2 to 6 hours in a flowing gaseous atmosphere of N<sub>2</sub> – 5% H<sub>2</sub>. This final heat treatment is performed in order to fix the valence state of the Eu coactivator to Eu<sup>2+</sup>. In yet another application to produce strontium aluminate phases by the present invention, it is permissible to mix the precursor oxide materials comprising strontium carbonate, alumina, anhydrous boric acid, rare earth and scandium oxide phases in a dry media ball mill for one to several hours. The action of the ball mill serves to homogenize and refine the individual oxide phase particle sizes to an extent that permits the calcination and strontium aluminate synthesis steps to be combined into a single process. In practicing the invention by this method, it is found that a ~~hearing~~ heating rate of between ~~100~~ 100°C to 200°C ~~200~~ degrees Celsius per hour to the reaction temperature is sufficient for

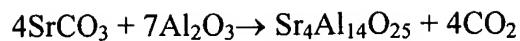
achieving the complete reaction and synthesis of the strontium aluminate phosphor. It is generally believed that Dy maintains a valence state of Dy<sup>3+</sup> subsequent to this treatment as do the other REM coactivators such as Gd, La, Nd, etc., when present. It is further believed that Sc undergoes an ionization step to produce a Sc<sup>3+</sup> ion when the strontium aluminate is treated according to the above methods.

Please replace Paragraph [0024] with the following amended paragraph:

[0024] As shown in Figure 1, the afterglow characteristics of this type of composition, with and without scandium, are compared. In Figure 1 the strontium aluminate base material was synthesized at approximately 1300°C 1300°C and subsequently exposed to ultraviolet excitation for about five (5) minutes, wherein it was synthesized at approximately 1450°C 1450°C in Figure 2. The solid horizontal line in all of the Figures represents the commonly accepted light detection limit for the human eye under fully dark-adapted conditions. As can clearly be seen the luminescence of the materials containing scandium are higher than for those formulations without scandium.

Please replace Paragraph [0025] with the following amended paragraph:

[0025] A second application of the invention involves the synthesis of Sr<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>:Eu,Dy,Sc and Sr<sub>4</sub>Al<sub>14</sub>O<sub>25</sub>:Eu,Sc according to the method described above wherein the following components are combined according to the reaction:



in which the following proportions of example feedstocks were utilized:

$\text{SrCO}_3$  (4.0 mole)

$\text{Al}_2\text{O}_3$  (7.0 mole)

$\text{Eu}_2\text{O}_3$  (0.005 mole)

$\text{Dy}_2\text{O}_3$  (0.01 mole)

$\text{Sc}_2\text{O}_3$  (0.005 mole)

$\text{B}_2\text{O}_3$  (0.2 mole)

Please replace Paragraph [0026] with the following amended paragraph:

[0026] Figure 3 shows the photoluminescence performance of this material both with and without scandium. The strontium aluminate base material was synthesized at approximately ~~1300°C~~ 1300°C. Again, those formulations containing scandium have superior performance compared to those without it.